

accredited dictum of science as are the other doctrines of the correlation of the physical forces and of the correlation of the vital and physical forces which have been its necessary predecessors."

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Prismatic Ice—Sandstone Boulder in Granite.

THE "two phenomena" observed on Dartmoor by Mr. C. Spence Bate and Mr. W. Morrison, and described by the former in *NATURE* of the 31st ult., have been previously noticed.

The late Rev. Dr. Scoresby, F.R.S., published a paper "On Columnar Crystallisation of Ground Ice," in the *Edinburgh New Philosophical Journal* for January 1850 (vol. xlviii.), and illustrated it with a plate containing eighteen figures. A presentation copy of this paper is now before me.

The so-called *sandstone boulders* in granite are by no means rare. They occur in various parts of Devon and Cornwall. I first noticed them at Shapton, near Bovey Tracey, in Devonshire, and have subsequently seen them in several other localities, but nowhere in such abundance as at Sennen Cove, near the Land's End, in Cornwall. There are several good specimens in my private collection. The following description of them occurs in a paper on "The Age of the Dartmoor Granites," which I read to the British Association at Manchester, and to the Royal Geological Society of Cornwall in 1861, as well as to the Devonshire Association in 1862. "Nodules, apparently segregative, sometimes occurring in the substance of the ordinary granite, might, from the fineness of their grain, be almost mistaken for sandstone; indeed, I not long since heard them appealed to as proofs of the metamorphic origin of granite. 'Here,' said the appellant, 'are unaltered remnants of the old sandstone rocks, which, with these exceptions, metamorphism has converted into granite. I do not quote this for the purpose of endorsing it, but simply to show the general dissimilarity of the nodules to granite proper. Excepting their darker colour, they reminded me much of the granite veins which pass through the older granite of Goatfell, in the Isle of Arran; nevertheless, they are not veins but nodules, and capable of being extracted as such from the granitic mass containing them. . . . They consist of very fine grains of quartz and schorl in about equal quantities, or with the latter somewhat preponderating.'"

Irrespective of the origin of the nodules, it is no doubt "clear that when this granite was formed, the temperature of (the surface of) the earth must have cooled down to below the boiling point of water," for the granite, as has long been established, is of post-carboniferous age; or, in other words, was formed after the rich faunas and floras of the Silurian, Devonian, and Carboniferous periods had successively passed away, to say nothing of the pre-Silurian organic eras.

WM. PENGELLY

Torquay, April 2

The Transits of Venus in 1874 and 1882

IN the paper on this subject by P. L. S., there occurs a remark which is calculated to convey a mistaken impression. He states that "an Antarctic station is only required for the transit of 1882, and there is ample time to make a preparatory Antarctic expedition to ascertain" whether a suitable station can be found. The reverse is the case. No Antarctic expedition can be of any service in 1882, so that in a preparatory expedition the lives of our seamen and men of science would be uselessly risked. On the contrary, there are several Antarctic stations suitable for observing the transit of 1874; and I have shown that the comparison of observations made at such stations with observations made in Siberia would give the most effective means of determining the sun's distance available before the 21st century.

I may remark here, that the choice of stations for observing the transits of 1874 has been founded on calculations admittedly inexact, and it would be to the credit of English astronomy that the whole matter should be re-examined while there is yet time for a change to be made. In saying this, I am not by any means insisting upon the views put forward in my own papers on the subject; though the only error pointed out by the Astronomer Royal in my charts and calculations consists in the fact that they aim at an unnecessary exactness. But the utilisation of the

coming transits is a matter too important to be endangered for any personal considerations whatever. If errors have been made it behoves men of science to see that those errors shall not be suffered to prejudice the cause of scientific progress.

RICHARD A. PROCTOR

Euclid as a Text-book

I REGRET that Mr. Wormell has imported so much of a personal nature into his reply to my former letter. Personality and unintentional misrepresentation appear to me to be its predominant features. Unintentional, I say, for I know little of the writer beyond the fact of his being the author of two or more admirable text-books, and that he is a distinguished member of the London University.

Though I feel that the columns of *NATURE* ought hardly to be taken up with such matter, yet, in self-defence, I am compelled to say a few words. As I have neither time nor inclination for controversy, I hope that the discussion, if continued, will be entirely *ad rem*, and not diverge into personalities. Owing all my geometrical ability (*quod sentio quam sit exiguum*) to a twenty-three years' acquaintance with Euclid, and having had, as a teacher, to use that author for the last fourteen years, it would not be strange if I were a favourer of the old system, which I am not to the extent Mr. Wormell seems to think.

My plan of teaching geometry under the old system was to overcome Euclid's deficiencies by *viva voce* explanation, and, offering slight assistance, to get my classes to work a number of geometrical exercises. With my sixth class I have generally got well through three or four hundred such exercises as are given in Todhunter's edition of the Elements.

This is not the same as sending out boys who have merely "committed Euclid to memory," and certainly my pupils have found no great difficulty in the matriculation papers. Pupils thus prepared have taken first, second, third, and other high places in the examination, which places, I think, were in a measure due to their "flooring" the geometrical papers—with the exception, perhaps, of a "rider;" also, during the time I have held my present post, my pupils have carried off the Andrews Entrance Exhibition at University College each year, with one exception, when the finest geometer I have had was beaten. This is not the place for chronicling successes in other examinations.

I did not state that it was advisable for students to read Euclid only; what I did say was to the effect that I had heard of boys who were doing this with the idea that such a course would "pay" best. Mr. Wormell charges me with using an "infelicitous and ungenerous expression." That I willingly retract, as it has struck myself as being uncalled for; but Mr. Wormell must have read my purposely concise letter hastily, for I nowhere say that I desire a change in the syllabus; the syllabus is excellent, and I quite agree with him in the remarks he adds about the "unflinching courage in the reform of English methods of education" as far as regards the matter under discussion. But what is possible is, that the examiners, being chosen from the older universities, may overlook this distinction; until now, I have had to regard the papers from the old point of view, in which light they have suited me exactly; Mr. Wormell has viewed them from the modern stand-point, and bears the like testimony; this being so, it must be admitted that the examiners have well carried out the syllabus. That I should "impeach the integrity" of such men as the present examiner, from whom I have always experienced the greatest kindness, or the late examiner, one of the most successful teachers of my own university, would be absurd, were it not that it pains me to have it supposed. To return, I do not want quite such a change as Mr. Wormell thinks; the difficulty in my case has not yet arisen, for I have not yet sent in pupils whose training has been wholly confined to the new Geometry, and I wished to have the change made, if any were necessary, before sending them in. The difficulty will not be so great when we have obtained a thoroughly good modern text-book; ours is a very good one, but there are blemishes which will doubtless be removed in a new edition, and to adapt it to the matriculation scheme more propositions than at present must be proved, as I think, independent of proportion. I applied the term "Euclidean type" to the recent examination paper, because the questions are given in the exact words of Euclid; I would have this changed; they follow in the order assigned in the Elements, and perhaps my experience of

* See *Geologist*, 1863, p. 15; Trans. Roy. Geol. Soc. Com., vol. vii., p. 425; or Trans. Dev. Assoc., 1862, p. 50.

Cambridge Examinations leads me erroneously to think that the proofs are expected to be given in the same order. In drawing this personal statement to a close, I may say that I am not singular in the view I took, as I learn from several gentlemen who have spoken to me on the point, and indeed, had it not been that the authorities* of University College School thought I had some ground for my views, I should have kept silence altogether. I believe the matter will come under the consideration of the proper authorities, and in their hands I am perfectly willing to leave the settlement of the question, if there be any need for a change.

R. TUCKER

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Science and the University of Cambridge

ONE of the last sentences in your paragraph concerning the report of the Syndicate for providing better opportunities for the study of physical science in the University of Cambridge, though founded upon a partial misconception of the state of affairs, suggests what is probably the best solution of the difficulty. The colleges, if polled upon the simple question, "Shall we aid in promoting the study of physical science?" would, I believe, reply by a considerable majority in the affirmative. It is upon the best mode of contributing that there is so much division of opinion; and this has caused the apparently "lame and impotent conclusion."

The question of taxing the college revenues is one of considerable difficulty; some colleges already support out of their corporate funds teachers of natural science, some have recently taxed themselves heavily to improve their buildings.

Most would think that non-resident fellows who do little for the college should be taxed more heavily than those who reside to do much work for no great amount of pay; but to bring about this would require much alteration of statutes. The question, therefore, being so complicated, and there being, as I believe, a general willingness to contribute, if only a just and equitable mode of raising the funds can be devised, and proper control retained over them (for the University is not generally considered to manage its property so well as the colleges), I believe that the difficulties would be most simply solved by the appointment of a commission composed of a few well-qualified persons, thoroughly acquainted with the University, to devise a scheme and to draw up an act for carrying it into effect.

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EXPLORATION OF CAVES AT SETTLE, YORKSHIRE

IN the mountain limestone of the West Riding are many caves, some of which are empty, some traversed by water, which is silting up their lower chambers, while others are full up to the very roof with débris of various kinds. All have been, at some time or other, subterranean watercourses, and have been formed, partly by the friction of the substances set in motion by the current, but principally by the chemical action of the carbonic acid of the rain-water by which the insoluble carbonate of lime in the rock is converted into the soluble bicarbonate. Some have been inhabited, at various times, by man, and by wild beasts, and therefore may be expected to furnish valuable evidence of a condition of things that has now passed away. The last recorded case of their being used by man as a place of refuge was during the rebellion of 1745, when the eldest son of one of the gentlemen in the neighbourhood was hidden in a large cave, in the fear that the Scotch would pass southwards in that direction instead of by the Preston route.

The gentlemen of the West Riding have formed a committee for the systematic exploration of these caves, and will doubtless obtain from them evidence of the very highest archaeological value, relating to a time of which we know next to nothing,—that begins with the disappearance of the mammoth, hyæna, and lion from Northern Europe,

* What strong views in favour of the modern methods are held by Prof. Key, may be seen from Prof. Hirst's preface to our *Geometry*.

and extends as far down as the dawn of history in Britain, during which the neolithic and bronze-using races spread over Europe from the south-east. The older caves have been explored in many parts of Britain, while the pre-historic of the later have only been systematically examined in Somersetshire and Denbighshire by myself and Mr. Sanford. That the work in Yorkshire is planned well is clear from the following extracts from the Resolutions:—

That the following scheme, proposed by Sir James Kay-Shuttleworth (chairman), be adopted, viz. :—

1. To examine the ground around the mouth of the caves for signs of fire, implements, utensils, remnants of food, or traces of sepulture.

2. To make a survey of the caves in order to provide a plan of the interior drawn to scale, and of a sufficient size to enable a record to be made on it of the situation in which each thing is found.

3. To ascertain by one or more vertical excavations of limited extent what are the deposits chronologically arranged.

4. Then to proceed to examine these strata from the mouth of the cave inwards, so as to secure the discovery of all remains throwing any light on the history of each stratum.

5. To keep a record of the things discovered.

The first cave chosen by the committee is that found by Mr. Jackson, high up in a limestone cliff near Settle, on the coronation-day of our Queen, and which is therefore known as "the Victoria cave." It consists of a series of large chambers and passages, which are nearly filled to the roof with a reddish grey clay and stones. It must at one time have been of wonderful beauty, for there are the remains of massive stalactites, and of thick stalagmitic pavements; but now these are so decomposed by the carbonic acid that they are reduced to the condition of very soft mortar. Curiosity-hunters have also been doing their usual ruthless mischief. When it was first opened, Mr. Jackson obtained from a chamber at the original entrance a large series of ornaments and implements of bronze, iron, and bone, along with pottery and remains of animals. There are in his collection bronze fibulæ, iron spear-heads, iron nails, bone spoons, spindle whorls of stone and pottery, fragments of Samian ware, and other pottery turned in a lathe, cockle-shells, flint flakes, whetstones and stone balls. The remains found with these belong to the red deer, roebuck, pig, horse, and Celtic short-horn (*Bos longifrons*), sheep or goat, badger, fox, otter, and dog. There are also Roman coins of bronze and silver. All these were derived from a superficial deposit, and could not be assigned to an earlier date than that of the Roman occupation. The pottery was of the same kind as that so commonly found in the refuse heaps near Roman villas. It is worthy of note that the two domestic animals, the Celtic short-horn and the sheep or goat, were those that had been most abundantly used for food. The exploration committee resolved to follow up this discovery by a thorough examination of the cave, which they are able to undertake by the courteous permission of the owner, Mr. Stackhouse.

Outside the entrance of the cave, and at a lower level, is a small plateau composed of débris, which occupies the exact point where daylight could be seen through chinks, from the inside of one of the large chambers. As both the plateau and the chamber were undisturbed, the committee determined to begin work by removing the débris and making a new entrance into the cave. While this was being done, the following section was exposed. On the surface there was a layer of fragments of limestone that had fallen from the cliff above, two feet in thickness. Underneath was a layer of dark earth with stones about eighteen inches in thickness. It furnished large quantities of bones, nearly all of which had been used for food, and several articles of bronze, iron, or bone of the same kind and age as those I have already mentioned. The pottery is also of the same Roman character. Fragments of charcoal were also abundant, and stones bearing the